Contents

CHAPTER ONE

Introduction

1.1. Introduction

Transportation is expected to play a key role in fueling the growth of the overall lubricants market, owing to the increased number of on road vehicles. It accounted for the largest market share in the global lubricants market in 2016. However the industrial machinery & equipment is projected to be the fastest-growing application will be between 2016 and 2021.

Few factors provide a degree of impetus towards the otherwise lackluster lubricants consumption experienced during recent tear in the industry in Sri Lanka. Amongst these factors was the registration of new motor vehicles during the year. As per the departments of motor traffic data, the year 2015 witnessed a record number of new motor vehicles registration in the country, which translated to a 56% year on year increase over 2014. Import duty reduction is the major factor of this increments. But Since the year of 2016 this new vehicles registration drastically decrease due to increments of the import taxes and after the 2017 November it's come again to increasing trend.

Demand for the lubricants from the agriculture and fisheries sectors were relatively stable and less disrupted by the adverse weather pattern. And also gradually reduction in lubricant consumption due to the change in source of national energy mix continued during the year. The lubricant intensive thermal power contribution to the energy grid was significantly curtailed with the substitution of coal power energy, whilst hydro and renewable energy mostly formed the balance mix. The gradual migration in consumer demand from lower- tier lubricants to the high-tier lubricants to reap the technological products benefits continued during the year. This entails the functional benefits of longer oil drain intervals and consequently compresses lubricants volume in the industry due to less frequent oil fills.

Further Impediments to the growth in the lubricants demand was the slow- down in the construction industry and rubber exporting oriented industries in particular. The activities of the construction industry were curtailed during the year as large scale infrastructure projects were

temporarily deferred due to pending reassessments, whilst certain projects reached maturity and completion. Meanwhile the growth of rubber export oriented industries, were challenged by the macro- economic dynamics of the export destination countries. Considering the forces affecting the lubricant industry outlier above, competition remained wide- spread and aggressive.

1.2. Introduction of lubricants

Lubrication is that the method or technique utilized to cut back friction between, and wear of one or each, surfaces in proximity and moving relative to every different, by interposing a substance referred to as a lubricator in between them. The science of friction, lubrication and wear is named mechanical engineering.

Typically lubricants contain 90 percent of base oil and fewer than 100 percent additives. Vegetable oils or artificial liquids like alter polyolefin, esters, silicones, fluorocarbons and plenty of others area unit generally used as base oils.

A true grease consists of an oil and different fluid stuff that's mixed with a thickening, generally a soap, to make a solid or solid. It is typically applied victimization a grease gun, that applies the grease to the half being greased stressed, forcing the solid grease into the areas within the half.

Lubricants aren't simply oils for automobile engines; there are many different types including metalworking fluids, transformer oils, gear and hydraulic oils. Fluid oils and greases, both solid and semi-solid, are also used for lubrication.

There are 3 categories of lubricator base oils. They are as follows,

a. Mineral base oils - Originated from crude oil
b. Synthetic base oils - These are from synthesized components
c. Semi-synthetic base oils - This provides many of the advantages of synthetic oils

Additives are unit blending with base oils and also the combination, quality and amount of the additives and base oils confirm the standard and also the properties of the finished lubricator.

1.2.1. **Mineral base oils**

Mineral oil is created by distilling and processing oil. Its properties rely mostly on the standard and consistency of the oil from that it's refined and on the processing method itself.

Mineral base oil could be a mix of refined distillation fractions that result from vacuum distillation. It consists of hydrocarbons and traces of sulphur, chemical element and element containing hydrocarbons. The distillation fraction is additional pure by extraction and by separating the waxes. The purification method is completed with hydro-finishing that involves contact with gas at an air mass and temperature, within the presence of a catalyst.

1.2.2. **Synthetic oil**

The properties of artificial oil are determined entirely by its producing method. Artificial oils are freed from impurities and usually have higher viscosity and better chemical reaction stability than mineral base oils, leading to a higher and longer lasting performance.

1.2.3. **Semi-synthetic oil**

Semi-synthetic oils are integrated from a mixture of mineral and artificial base oils that provides a number of the advantages of artificial oil.

Lubricants containing oil have additives that enhance, add or suppress properties inside the bottom oil. The quantity of additives depends on the kind of oil and therefore the application that it'll be used. For example, engine oil may need a dispersant extra. A dispersant keeps insoluble matter conglomerated along to be removed by the filter upon circulation. In environments that bear extremes in temperature, from cold to hot, a consistence index (VI) improver is also extra. These additives square measure long organic molecules that keep concentrated along in cold conditions and unravel in hotter environments. This method changes the oil’s consistence and permits it to flow higher in cold conditions whereas still maintaining its high-temperature properties. The sole downside with additives is that they will be depleted, and so as to revive them back to decent levels, typically the oil volume should get replaced.

Reducing friction could be a key objective of lubrication, however there are several different advantages of this method. Lubricating films will facilitate forestall corrosion by protective the surface from water and different corrosive substances. Additionally, they play a vital role in dominant contamination at intervals systems. The material works as a passage during which it transports contaminants to filters to be removed. These fluids additionally aid in temperature management by gripping heat from surfaces and transferring it to some extent of lower temperature wherever it may be dissipated.

There are 3 differing types of lubrication: boundary, mixed and full film. Every sort is totally different, however all of them admit a material and also the additives at intervals the oils to safeguard against wear.

Full-film lubrication may be diminished into 2 forms: hydraulics and elastohydrodynamic. Hydraulics lubrication happens once 2 surfaces in sloppy motion (relative to every other) are totally separated by a movie of fluid. Elastohydrodynamic lubrication is comparable however happens once the surfaces are in an exceedingly rolling motion (relative to every other). The film layer in elastohydrodynamic conditions is far agent than that of hydraulics lubrication, and also the pressure on the film is larger. It is referred to as elastohydrodynamic as a result of the film elastically deforms the rolling surface to lubricate it.

Even on the foremost polished and swish surfaces, irregularities are gift. They stick out of the surface forming peaks and valleys at a microscopic level. These peaks are referred to as asperities. So as for full-film conditions to be met, the lubricating film should be thicker than the length of the asperities. This kind of lubrication protects surfaces the foremost effectively and is that the most desired.

Boundary lubrication is found wherever there are frequent starts and stops, and wherever shock-loading conditions are gift. Some oils have extreme-pressure (EP) or anti-wear (AW) additives to assist shield surfaces within the event that full films cannot be achieved owing to speed, load or different factors. These additives take hold metal surfaces and type a putting to death layer that protects the metal from wear. Boundary lubrication happens once the 2 surfaces are contacting in such how that solely the EP or AW layer is all that's protective them. This can be not ideal, because it causes high friction, heat and different undesirable effects.

Mixed lubrication could be a cross between boundary and fluid mechanics lubrication. Whereas the majority of the surfaces are separated by a lubricating layer, the asperities still build contact with one another. This can be wherever the additives once more get play.

With a much better understanding of this method, it ought to be easier to outline what lubrication truly is. It's a method of either separating surfaces or protective them during a manner to scale back friction, heat, wear and energy consumption. This will be accomplished by victimization oils, greases, gases or different fluids.

1.3. Function of Lubricants

1.3.1. **Reduced friction**

Lubricant forms associate degree oil film on the surface of metals, changing solid friction into liquid friction to cut back friction that is that the most typical and essential perform of lubricants. Reduced friction prevents heating and abrasion on the friction surface.

1.3.2. **Cooling**

Friction actually causes heating on the world and a lot of heat is created if metals rub against one another. So the warmth must be absorbed or released; otherwise the system is destroyed or ill-shapen. To forestall it, lubricants square measure applied. Particularly cooling is essential to rolling oils, cutting oils, and lubricating oils utilized in an interior combustion engine.

1.3.3. **Load equalization**

Components like gear or bearing square measure limitedly contacted on an explicit line or surface, thus load is multiplied during a moment, creating systems in danger for being destroyed and connected to every different. So the appliance of material protects systems against multiplied load by forming associate degree oil film to disperse load within the film.

1.3.4. **Cleaning**

Long-term use of systems might result in corrosion or aging, manufacturing foreign substances. Just in case of victimization hydraulic oil and kit oil, sediments accumulate like sludge from deterioration. Particularly an interior combustion engine generates an excessive amount of soot, in order that it's possible to shorten the lifetime of systems and create them fail to figure properly. So material it-self cleans out foreign substances like soap.

1.3.5. **Sealing**

Sealing is to shut the macro-gap between systems. Waterproofing the house between pistons and cylinders within the combustion engines or air compressors blocks the outpouring of combustion gas and also the influx of external foreign substances to keep up the outlined internal pressure and shield the system. Particularly within the mechanism, lubricants itself serve to forestall the outpouring by making a hydraulic film.

1.3.6. **Rust hindrance**

Metals manufacture rust once contacting water and gas. However, rust formation is controlled and also the system period is extended if the surface of metals is coated with lubricating film.

It is essentially needed to grasp the properties of lubricators and therefore the properties need to describe them so as to pick out the proper lubricant product.

1.4. Lubricants Classification

1.4.1. Classification by material

A lubricator refers to a substance that creates components of one thing move swimmingly and liquid lubricants account for concerning eightieth of it. Lubricants are unit developed victimization base oils made from fossil fuel purification by adding additives per combination quantitative relation for every use or developed by change of integrity chemicals like PAO.

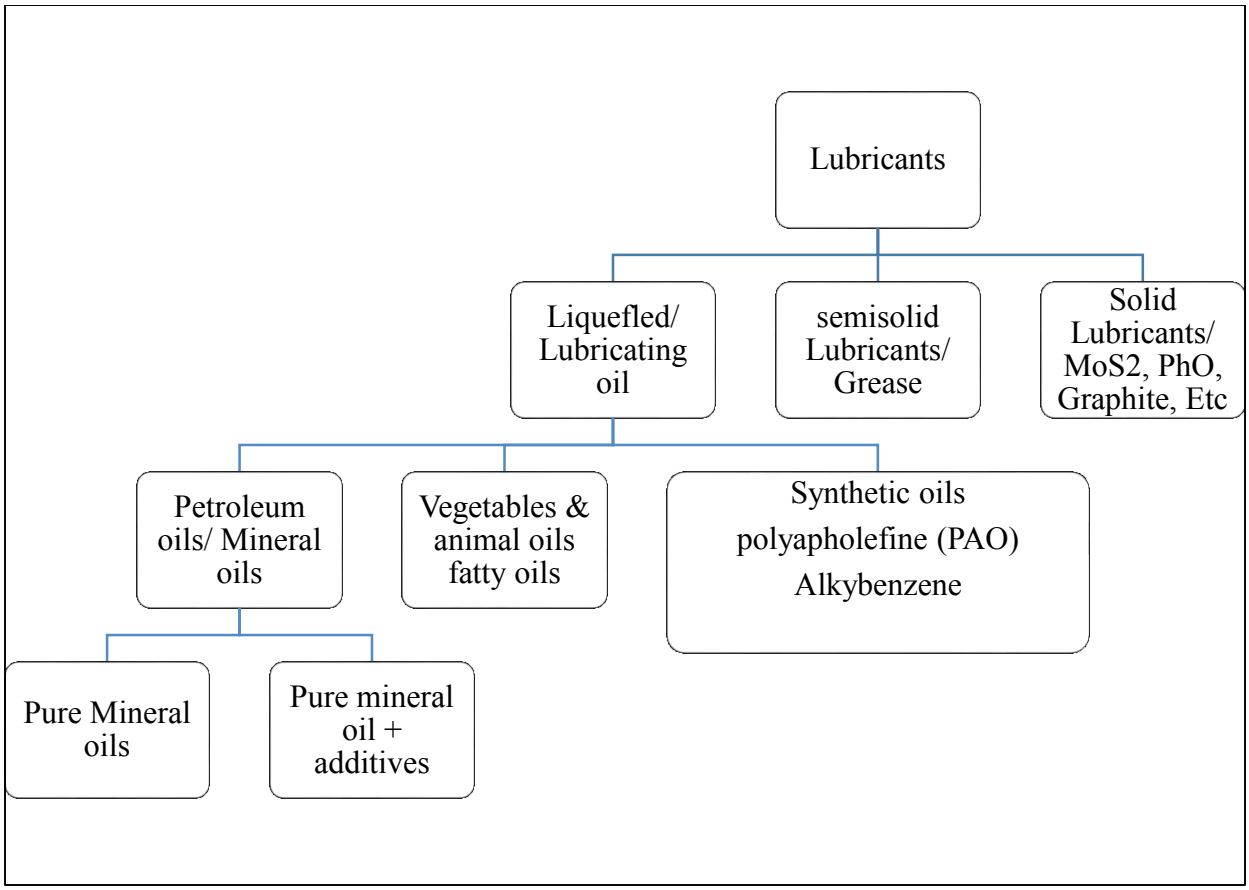

Figure 01: Lubricants classification by material with examples

1.4.2. Classification by use

Lubricants are largely used for automobiles, heavy industries, industries, and vessels.

Table 01: Lubricant Classification

For Transportation Facilities	**For Industrial Machine**
- Diesel Engine Oil - Gasoline Engine Oil - Diesel-electric locomotive Engine Oil - Aerometer Engine Oil - LPG Engine Oil - CNG Engine Oil - Motorcycle Engine Oil - 2-cycle Motor Engine Oil - Automatic Transmission Oil - Automotive Gear Oil	- Hydraulic Oil - Machine Oil - Industrial Gear Oil - Turbine Oil - Circulating Oil - Compressor Oil - Refrigerant Oil
For Vessel	**Metal-working Oil**
- Cylinder Oil - Trunk Piston Oil - System Oil	- Cutting Oil - Rolling Oil - Heat Treating Oil - Inhibited Oil

Others	- Process Oil - Electrical Insulating Oil - Grease

1.4.3. Classification by Viscosity

1.4.3.1. Mono Grade

The products of grades expressed in a single number such as SAE 10W and SAE 30 and viscosity can be identified according to the viscosity grades in SAE Table below.

Table 02: SAE viscosity grades

Viscosity Grade	Minimum Viscosity @ 100°C (cSt.)	Maximum Viscosity @ 100°C (cSt.)	Maximum Cranking Viscosity (cP) @ Temp. (°C)	Maximum Pumping Viscosity (cP) @ Temp. (°C)
0W	3.8	-	6,200 @ -35	60,000 @ -40
5W	3.8	-	6,600 @ -30	60,000 @ -35
10W	4.1	-	7,000 @ -25	60,000 @ -30
15W	5.6	-	7,000 @ -20	60,000 @ -25
20W	5.6	-	9,500 @ -15	60,000 @ -20
25W	9.3	-	13,000 @ -10	60,000 @ -15
20	5.6	< 9.3	-	-
30	9.3	< 12.5	-	-
40	12.5	< 16.3	-	-
50	16.3	< 21.9	-	-
60	21.9	< 26.1	-	-

Source: SAE

1.4.3.2. Multi Grade

The products of grades expressed in two kinds of numbers such as SAE 5W30 and SAE 10W40, which means the two SAE grades specified in the viscosity tables are both satisfied.

The viciousness modification of multi-grade lubricating oils at extreme temperature is smaller than that of single-grade lubricating oils, providing economic edges. Multi-grade lubricating oils area unit additional liquid at cold than single-grade lubricating oils, so they improve fuel potency of an enclosed combustion engine. Conjointly most multi-grade oils have higher wear resistance performance than single-grade oils, extending the lifetime of elements of an enclosed combustion engine.

1.4.4. Classification by performance

The American Petroleum Institute (API) formally acknowledged standards for the standard of engine oil that suits every engine following the proliferation of vehicles within the decennial and specific them in signs that are classified mostly into hydrocarbon and diesel. Hydrocarbon is marked in S (Service Category) and Diesel is marked in C (Commercial Category), and so supplementary by A, B, C, D, then on to differentiate their grades. Since the most recent engine models are additional needed to figure in harsher atmosphere beneath tighter laws, they satisfy additional strict laws than previous grades.

Table 03: API Classification

Gasoline Engine Oil		**Diesel Engine Oil**	
Grade	**Year**	**Grade**	**Year**
SN	2011	CJ-4	2007
SM	2004	CI-4	2002
SL	2001	CH-4	1998
SJ	1996	CG-4	1995
SH	1993	CF/CF-2	1994

Grade	Year	Grade	Year
SG	1989	CF-4	1990
SF	1980	CD- Ⅱ	1985
SE	1972	CE	1984
SD	1968	CC	1961
SC	1964	CD	1955
SB	1930	CB	1949
SA	1900	CA	1900

Source: API

1.5. Introduction to company

LAUGFS Holdings is one of the largest diversified business conglomerates in Sri Lanka. LAUGFS has founded in 1995 and LAUGFS currently has expanded across 20 industries, establishing a strong presence as a leader and pioneer in the power and energy, retail, industrial, services, leisure, logistics and the real estate sectors in Sri Lanka. LAUGFS newly become a local multinational with starting of a business in the Bangladesh as well as Dubai. Currently LAUGFS manage with over 4,000 employees and an annual turnover exceeding Rs.28 billion, LAUGFS continues to expand, in pharmaceutical, solar power industry.

LAUGFS Lubricant limited was incorporated in 2008 as private liability company. Initially company started imported and distribution of lubricants under the license given by ministry of the petroleum. In the year 2015 company began new era with the modern state of art blending plant. Currently company selling lubricants under the Automotive and Industrial Category.

1.6. Company products type

Mainly there are 7 categories of lubricants products mention as follows.

1.6.1. Diesel engine oil - HEAVY DUTY DIESEL ENGINE OILS

- D-TRON - Diesel Multigrade Engine Oil-SAE 15W-40

  D-TRON is high performance, Multigrade, heavy-duty diesel engine oil specifically formulated with highly purified API group 2 base oils and new generation additive technology.
- POWER D40+ - Diesel Monograde Engine Oil-SAE 40

  Power D40+ oils SAE40 mono-grade high performance, high speed automotive diesel engine oil designed for a wide range of diesel engines operating under severe service conditions.

1.6.2. Petrol engine oil - PASSENGER CAR MOTOR OILS

- SUPREME PETRA SAE 15W-40 - Multigrade Petrol Engine

  High quality engine oil for use in modern petrol passenger car and light-duty commercial vehicle engines where APISN, SM, SL are required. Supreme Petra Multi grade will
  - Maintain engine cleanliness
  - Reduce wear & tear
  - Prolong engine life
- POWER P+ - Monograde Petrol Engine Oil-SAE 40

  High quality mono grade engine oil for use in petrol passenger car and light-duty commercial vehicle engines where APISJ, SH, SG & SF are required. PowerP40will:
  - Provide protection to engine
  - Maintain engine cleanliness
  - Reduce wear & tear
- SUPREME PETRA SAE 10W-30 – Multigrade Petrol Engine Oil

  Latest Generation of Multi grade Petrol Engine oil suitable for use in modern petrol passenger car engines where API SN, SM, and SL are required. Supreme Petra SAE 10W 30 Multigrade will:
  - Maintain engine cleanliness
  - Reduce wear & tear
  - Prolong engine life
- SUPREME PETRA SAE 0W-20 HYBRID OIL – Multigrade Petrol Engine Oil

Latest Generation of Multi grade Petrol Engine oil suitable for use in modern petrol passenger car engines where API SN, SM, and SL are required. Supreme Petra SAE 0W 20 Multigrade will:

- Maintain engine cleanliness
- Reduce wear & tear
- Prolong engine life

- SUPREME GOLD – Fully Synthetic Engine Oil

  LAUGFS Supreme Gold SAE 5W-40 is a multigrade, fully synthetic motor engine oil, specially formulated with selected synthetic base oils & reduced levels of SAPS to provide maximum durability of the latest low emission vehicle technologies.

1.6.3. Motorcycle oils - REVTRON 4T

- REVTRON 4T SAE 10W-30 – Four stroke motorcycle oil

  LAUGFS REVTRON 4T, SAE 10W 30 is high performance four stroke motor cycle oil formulated with highly refined premium quality mineral base oils and advanced additive system to meet the lubrication needs of latest four stroke engine designs.
- REVTRON SAE 20W-40 – Four stroke motorcycle oil

  REVTRON 4T SAE 20W-40 is a Premium performance, shear stable, Multigrade; multifunctional fluid specifically designed for use in four strokes motor cycle engines requiring JASOMA / MA 2 lubricants (also meets API SL).
- REVTRON 4T SAE 20W–50 – Four stroke motorcycle oil

  LAUGFS REVTRON 4T SAE 20W-50 is a Premium performance, shear stable, Multigrade; multifunctional fluid specifically designed for use in four strokes motor cycle engines requiring JASOMA / MA 2 lubricants (also meets APISL).

1.6.4. Three Wheeler Oils – ACTRON

- ACTRON 2T – 2 stroke three wheeler engine oil

  Actron 2T is Two - Stroke 3-Wheeler Engine Oil formulated with a special low ash additive system and with PIB (polyisobutene) technology. It is prediluted with a high flashpoint solvent

to facilitate mixing with petrol at all temperatures. Designed for engines requiring JASOF Cor ISOEGC performance lubricants.

- ACTRON 4T SAE 20W-50 – 4 stroke three wheeler engine oil

  Actron 4T SAE 20W-50 is a Premium performance, shear stable, Multigrade; multifunctional fluid specifically designed for use in Four Stroke Three Wheeler engines requiring JASOMA / MA 2 lubricants (also meets APISL). This has special frictional properties to facilitate smooth clutch release and anti-wear properties to protect gear box and engine parts

1.6.5. Automotive Speciality oil

- GEARON X SAE 90 & 140 – Manual gear oil

  High performance, EP automotive gear oil specifically designed for limited slip rear drive differentials, particularly those of the cone clutch design. Its special friction properties provide smooth, noise free operation and extended life of these units.

- VELOMATIC ATF

  High performance, multipurpose, shear stable, anti-wear automatic transmission fluid (ATF) formulated with high performance hydro cracked base oil sand the latest additive technology suitable for use in transmissions, power steering and hydraulic systems.

- BRAKE & CLUTCH FLUID

  Designed for use in conventional hydraulic brake and clutch systems under normal service conditions, particularly service conditions where DOT 3 fluids are recommended.

1.6.6. Industrial oil

- LAUGFS CIRCULATION 100, 150 & 220

  LAUGFS circulation 100, 150&220 premium quality circulating oils, manufactured from highly refined paraffinic mineral oil, suitable for industrial circulation systems and general purpose lubrication. They are formulated with technologically advanced system of anti-wear additives in order to reduce component swear and extend the working life of equipment.

- LAUGFS HYDREX HD

  LAUGFS Hydrex oils are premium quality, anti-wear hydraulic fluid, designed for use in mobile and stationary high pressure hydraulic systems. They also find application as circulating oils, bearing oils and as gear lubricants. These oils are blended with highly purified API Group2 base oils with very high oxidation and thermal stability. Available in viscosity grades 32, 46, 68&100.
- LAUGFS INDUSTRIAL GEAR OIL 150

  LAUGFS Industrial Gear Oil 150, formulated with high quality mineral base oils and advanced additive technology is specially designed for the lubrication of heavy - duty industrial gears working under extreme pressure conditions.

1.6.7. Greases

- LUBREX RED 2

  LUBREX RED 2 premium Lubricating grease is designed for a wide variety of automotive, construction, chassis lubrication and Industrial Applications. It contains high quality mineral base oil and Lithium Complex thickener with EP additives, rust and oxidation inhibitors. As this grease uses a Lithium Complex thickener, it is structurally very stable and provides a longer life for grease.
- LUBREX AP-2 & AP-3

  Lubrex AP-2 & AP-3 are high quality all-purpose lithium greases formulated with high quality mineral base oil, Lithium thickener and performance enhancing additives. Designed to use in automotive & Industrial applications where specialized products such as complex & EP greases are not required.

1.7. Problem statements

1.7.1. Research Limitation

When in the process of achieving the objectives of this study certain barriers were identified, which are,

- Considering sales date only from Laugfs Lubricants limited

- Not consider marketing mix due some information are critical and some are not able to get for period which is studied.
- Export volume and paddy production only have yearly data.

1.8. Research Problem

"What are factors affecting to lubricants demand and how to forecast future sales based on identified factors?"

Company planning its sales beginning of the year and purchasing base oil through the agreements with vender in every year. Ones fix the agreements company need to purchase that agreed quantity. It was observed since 2015, every year base oil stock building month to month. This is lead to block the company money in stock and it lead to pay unnecessary interest for capital. And increase of inaccuracy rate of the sales forecast with actual sales lead to inaccuracy of the production, finance and managing other expenditure as well.

1.9. Objective of the study

The major objective of the study is to develop the sales forecasting models which can use for manage the inventory, finance,

The specific objectives of the study are;

- To identify the factors which is affecting to lubricants demand
- To find the relationship between identified factors, forecasted and actual sales
- Developing models for sales forecasting

1.10. Research Process

This research is mainly looking on fit the forecasting model for lubricant demand. This research consists of five main chapters,

Chapter 1 gives an overview about the background of the study area with the brief introduction to lubricants industry in Sri Lanka. The need for the research, research problem and objectives are identified and the significance of the research is justified. And scope and the limitations of the research are focused. Through the chapter 1, reader will understand the basic idea of the research and the importance of the research.

Chapter 2 was structured to establish the theoretical framework for the research and identify the factors which is affecting to lubricants demand and sales forecasting. And this chapter is the basis for identifying the analyzing method and the methodology. This consist the previous literature reviews and their findings with relevance to this research.

Chapter 3 explains the methodology used to reach the research findings. This will explain the research design, data gathering methods used population, sample design and the analysis method.

Chapter 4 was structured to present research findings. Basically it includes descriptive analysis of the demographic factors of lubricants industry related demand factor and demand forecasting and model development using correlation and regression analysis. In order to validate the supplier selection model, use past four year data and run the model.

Chapter 5 was structured for the conclusion and future research directions. It consist summary of research findings, recommendations, research limitations and future research directions.

1.11. Research Scope

This research conducting to identify the factors which is affecting to the lubricants demand and develop the forecasting model based on the identified factors. Here looking for literature review as well as the interview on the industry expert for identify the demand factor for lubricants and use company existing data secondary data for the analysis.

1.12. Significant of the study

Company planning sales before the staring year and fix the target revenue based on the sales. Then plan the material purchase, production, finance, expenditure, other back office work according to the sales. Therefore this is very important study for the company in order plan other related work

of the company. And also since more than 90% of material are importing, have a better forecast will lead to reduce the import of the country.

CHAPTER TWO

Literature Review

2.1. Introduction

Sales forecasting is fundamental for the business which is using push strategy to the production process. They are expecting future sales and do their material ordering, production, storing, managing other sub process as well. In this chapter summarize some related literature to the sales forecasting, inventory managements and demand factors. Here literature categories under four main sub topic such as Lubricants and Gas, Inventory Managements , Forecasting Technique and Demand Forecasting.

2.2. Related Literature

2.2.1. Lubricants and Gas

Osabuohien and Nima (2015) carried out market analysis and forecast for oil and GAS/ Lubricants market in Nigeria. They have main objectives such as market analysis of lubricants products and do the future forecast use actual data to forecast and estimate the error of the forecast. They have use different method to forecast lubricants demand and found different method give result with limited errors and fund the increasing pattern on lubricants demand.

This study mentioned the necessity for skilled management of stuff so as to provide additional commonplace merchandise, reduced value, optimized profit, reduced waste, effective line of communication, risk management. For any stuffs to interrupt even there should be an expert lubricant management that administrate and coordinate the remainder department for effective and prompt production management. Beside the market research, a competitive advantage technique is mentioned. The businesses contend with alternative competitors by reducing value of their merchandise while not reducing qualities. This may be done by partaking in production of lubricants which might cut back the value of production. Another technique to contend with alternative competitors is thru response, that's by responding to shoppers complain on time and conjointly by rendering some free services to the ultimate shoppers.

The study utilizes market research to search out most demandable merchandise and utilize the assembly rate to forecast future demand. The market research of lubricants merchandise in African country shows a good exceptional increase for the demand for many of the merchandise aside from a number of the merchandise. The explanations for such steady demand could also be because of some reasons like lack of correct awareness of such merchandise, inadequate distribution channels, inability to act on client feel back and high value of merchandise. the issues listed on top of has hindered wide unfold of stuff merchandise in African country as some customers have shaped the habit of victimization cheaper, simply accessible and standard product as substitute once face with the matter of value and accessibility while not considering the results of such merchandise on their engines or machines. From the analysis through with the chosen merchandise in mist of alternative merchandise, the height amount for lubricants in African country appears to be within the Months of October and June, these could also be because of the climatic conditions within the coastal space which can have an effect on the viciousness of the oil and eventually ends up in typically replacement of such lubricants.

The rate of merchandise purchases come or harm is very terribly low consistent with the autocorrelation analysis done by SPSS Statistics seventeen code victimization the merchandise knowledge. Comparison the forecasted values for the various merchandise with the first values and victimization the higher confidence limit and also the lower confidence limit, the forecasted values have a good degree of accuracy. The various ways wont to check the errors of the prognostication, conjointly shows that the prognostication done was with very little or no error in it. Finally, there'll be a motivating increase within the demand for stuff merchandise within the future some rarely decrease from time to time in Nigeria.

Manee Choo-Iead and Wattana Keawpoolpakorn (2013) done a Study of Factors Influencing Lubricant Purchases by Logistics, Mining and Construction Business Entrepreneurs in the Three Lower-North Thai Provinces of Uttaradit. They have use 150 sample for their survey. They have found main marketing mix including product, price, place, promotion mainly impact on purchasing decision. Other than the marketing mix Product quality, credit payments, delivery service and follow-up visit lead to take purchase decision on lubricants.

The most cogent buying issue of product is quality of product that is expounded to the study of Charoenprueksachart (2007) regarding the selling combine that influences material buying-decisions for PTT product within the marine business in Samut Prakarn, Samut Sakhon and Samut Songkram provinces. During this study, it had been found that buyers concentrate to maintaining the standard of the material. It had been additionally associated with Rojsanyakul (2001), whose study of market structure and shopping for behavior of car material oil found that buyers pay most attention to product quality. Finally, this was additionally associated with the study of Pongsakornsilpa (2003:12-15), that discovered that product and merchandise development businesses serve customers' want for increasing satisfaction.

The most cogent buying issue for worth is credit payment and low worth for prime quality, that is expounded to Pongsakornsilp (2003:12-15), that explicit that the corporate ought to set cheap costs for patrons. The aim of worth setting is to get competitive advantage and therefore the company will generate profits whereas being cheap for patrons. This is often additionally associated with Charoenprueksachart (2007), United Nations agency found that the primary priority of respondents is worth.

Highly cogent buying factors of place are purchase from distributors and salespersons and from outlets that have delivery service. This is often associated with Charoenprueksachart (2007), United Nations agency discovered that the very best priority is convenience in communications with salespersons and additionally associated with Pongsakornsilpa (2003), United Nations agency explicit that distribution ought to facilitate customers by delivering their product and services on time.

High cogent buying factors of promotion are follow-up visits by salespersons and advertising via varied channels that is expounded to Pongsakornsilp (2003), United Nations agency stressed the role of advertising and promotion in poignant decision-making behavior. This is often additionally associated with Uthaisri (2003), United Nations agency noted that advertisements and promotion are correlate with motor cycle material oil shopping for behavior in Krung Thep.

Consequently, producer corporations or distributors ought to contemplate the standard of lubricants as entrepreneurs need viscous, clear, 100% artificial material, that has potency in maintaining engine performance, an affordable worth for the standard, distribution through

convenience outlets and distributors, salespersons ought to visit and follow up and additionally ought to provide 60-day payment credit terms.

K line and company (2007) studied on Business Opportunities in the Emerging Lubricant Markets of South Asia, the Middle East, and Northern Africa, 2005-2015 and found GDP growth as well as growing disposable incomes, which is driving private vehicle ownership in these regions. Investments in transport infrastructure are facilitating greater vehicle use and are thereby contributing to an increase in lubricant demand.

The project team conducted in-person interviews in every of the leading lubricating substance intense country markets in the regions with:

- Leading customers of lubricants as well as finish users, channel players, and OEMs
- Leading makers and marketers of lubricants, base stocks, and additives
- Pertinent government agencies and trade associations

The report additionally attracts upon a quest of recent trade and technical literature; applied mathematics information from government agencies, trade associations, and trade organizations; and no confidential information from Kline's library and files. Primary analysis contains quite ninety fifth of the overall analysis methodology for this syndicated report. Forecasts during this report were generated with Kline's new Future View situation statement Model. With the enhanced forecasts, subscribers will see however changes in the assumptions behind the forecasts will bring about totally different outcomes.

2.2.2. Inventory Managements

KAWAMURA, NOMOTO and KUO (2015) studied on beer inventory Management based on Demand Forecasting on a traditional inn in japan. They have found ANN method and multiple regression analysis give better forecasting accuracy.

This study mentioned the problem of beer inventory management in Japanese ryokans supported demand statement. Keeping the building business in mind, models and ways have been planned to forecast and verify the appropriate safety stock levels. The endings show that the re-order criteria determined by the multiple correlation analysis and ANN square measure superior to it of company

A. Comparisons between the multiple correlation analysis and ANN reveal that ANN might cut back average shortages through each inventory stock surpluses and one hundred and twenty fifth and 5% permissible stock out rates. However, ANN had a lot of shortage days than the multiple correlation analysis at a permissible stock out rate of fifty. Such a little distinction between these 2 ways are often attributed to coincidence.

The ANN model is usually criticized for being a black box. However, it will approximate a large vary of non-linear functions once the relationships between the variables don't seem to be well understood. Therefore, the multiple regression analysis is simpler to modify as long as there is no significant distinction within the results.

This study by trial and error analyzed demand statement through multiple correlation analysis and ANN victimization beer sales data. The results indicated setting safety stock appears applicable for combining demand statement with customer info and management expertise. It should be noted that this study doesn't refute the qualitative aspects of managers' expertise and intuition, however it shows that internal control in ancient hotels is a lot of efficient once conducted through scientific management techniques.

ZIUKOV (2015) reviewed on the inventory managements models in the uncertainty. He is review the model which is consider facts such as single vs multiple item, time duration, number of stocking point, the nature of the products and nature of the demand. He has found most of the analytical model given answer only for one type of uncertainty and furthermore need to develop new models.

In the past years, the potency of inventory management has become a part of major concern in business. New inventory models for managing the inventory levels area unit currently available. This paper has conferred a literature survey of models of internal control underneath uncertainty. Most of the analytical models addressed only 1 kind of uncertainty and assumed a simple structure of the assembly method. The foremost common dimensions to be considered as fuzzy variables area unit demand, the value of acquisition. Each model, supported some assumptions, has its edges and downsides, but still, many authors still style internal control models victimization such approach as formal logic.

The existence of such amount of models shows that fuzzy pure mathematics is one in every of the appropriate ways, which may suppose a good advance in inventory management. The emphasis in every review was to spot however the fuzzy pure mathematics was utilized in the formulation of the inventory model. The classification and review of models area unit quite general and can be extended.

Hendel and Nevo (2006) studied on sales and consume inventory. They found several fact which is related to the demand, (i) Aggregate demand increases as a function of duration from previous sale, and this effect differs between sale and non- sale periods, (ii) Fraction of purchases on sale is higher in one market (the market that on average has larger houses), and if there is a dog in the house. Both of these measures could potentially be correlated with lower storage costs, (iii) When buying on sale, households tend to buy more quantity (by buying either more units or larger sizes), buy earlier, and postpone their next purchase, (iv) Inventory constructed under the assumption of fixed consumption over time is negatively correlated with quantity purchased and the probability of purchase.

In this article they tended to propose a model of client inventory holding. They tended to use the model to derive many implications that they tended to want the info. The info accommodates associate degree combination elaborate scanner dataset and a household-level dataset. They discovered many items of proof according to the model, (i) combination demand will increase as a perform of period from previous sale, and this effect differs between sale and no sale periods, (ii) Fraction of purchases on sale is higher in one market (the market that on the average has larger houses), and if there's a dog within the house. Both of these measures might doubtless be related to with lower storage prices, (iii) once shopping for on sale, households tend to shop for a lot of amount (by shopping for either a lot of units or larger sizes), buy earlier, and defer their next purchase, (iv) Inventory made beneath the idea of mounted consumption over time is negatively related to with amount purchased and therefore the chance of purchase, (v) The patterns of sales across totally different product classes are according to the variation in storage prices across these product. Calculations supported our findings recommend that within the presence of storage, normal static demand estimation could also be dishonorable. Static demand estimates, that neglect dynamics, may overestimate own-price elasticity.

2.2.3. Forecasting Technique

Kochak and Sharma (2015) studied on demand forecasting technique use for the consumer products. They have modeled by artificial intelligence approaches using artificial neural networks (ANN) and develop a method to forecast demand by using ANN.

In this project they have got discovered performance of product demand prognostication. The project is consumer product for future average. The effectiveness of prognostication the demand signals within the offer chain with ANN technique and establish the most effective coaching technique. This study has developed a cooperative prognostication mechanism supported ANN and coaching methods. The projected methodology, demand prognostication issue was investigated on a manufacturing company as a real-world case study. The result indicates a TrainLM technique performs a lot of effectively than the opposite tanning method and therefore the lot of reliable forecast for our case. The projected methodology will be considered as a productive call support tool in prognostication. The flexibility to extend forecasting accuracy can result. Future research will risk of victimization Artificial Neural Network to create the same approach and higher the accuracy.

Liu, Ren, Choi, Hui, and Ng (2013) studied sales forecasting method and its advantage and draw back in the fashion retailing service industries. They have found hybrid foresting model giving more accurate result than using one model for sales forecasting.

Sales statement could be a real-world downside in fashion merchandising. From the angle on applications and implementation, various problems square measure known. First, in terms of the statement horizon, most of the existing statement models square measure appropriate for middle-term and long-run statement. However, short-run statement, including the terribly short term statement like period forecasting, isn't however absolutely explored. This sort of short-run forecasting is incredibly necessary given the character of the style industry.

They have conducted a comprehensive review of the literature on fashion retail sales statement. They have explored the benefits and also the drawbacks of various types of analytical ways for fashion retail sales statement. They have conjointly examined the pertinent problems associated with real-world applications of the style retail sales statement models.

For fashion retail sales statement, relating to the data supply, there square measure 3 types of information, namely, the statistic information, crosswise information, and panel data. The statistic information, which is collected over discrete intervals of your time, is wide employed in fashion forecasting and also the ways applied to time-series data also are well developed. Crosswise information is collected over sample units in a very explicit period of time and panel information follows individual micro units over time. These 2 types of information aren't however absolutely used for fashion sales statement. Color is one vital part in fashion and it's highly associated with the inventory and production coming up with of fashion attire product. In fashion retail system, the sales of the attire product square measure powerfully influenced by the calendar issue, for example, holiday. On one hand, the stress on these specific dates square measure far more volatile and difficult to predict. On the opposite hand, the revenue that will be generated throughout these periods of your time can be huge. As a consequence, a way to exactly forecast the demand throughout special dates/events becomes crucial to fashion retailors.

Hadizadeh (2011) researched on quantitative forecasting methods on sales of Napthenic Oils in Sweden. He used some specific ways like ARIMA and decomposition, and the additional knowledge he tend to collect, the additional valid results he tend to could acquire. This will certainly influence the conclusion of this study that provides the simplest score to ARIMA and exponential smoothing. Moreover, over and below fitting as 2 vital expressions within the forecasting literature are on the far side the scope of this analysis whereas, at constant time could have a major influence on the validity of the statement ways.

Having studied and reviewed connected literature within the space of quantitative statement, he came to the present conclusion that the economic science methodology isn't a right possibility for this project principally due to the constraints that are mentioned in previous chapters. In statistic, choosing a particular methodology for the forecast of all merchandise can't be a right call. It’s supported the behavior of the info on that the analysis ought to be created. On the opposite hand, statistic methods are applicable once the system isn't we tend toll understood so difficult or we solely care regarding what is going to happen rather why it'll happen. If our purpose isn't solely to forecast the demand of doubtless essential merchandise however to provide special tools to managers to require right selections in several areas as well as sales, revenue management, evaluation and management of influencing factors, They got to use a way that not solely eases the

statement procedures and gets the precise projection of demand volume however also demonstrates effective variables on demand and suggests specific call for this behavior. To obtain this goal, it's suggested to own a mix of informative and statistical methods. That's why an additional advanced methodology of statement like regression model with ARIMA errors has been instructed. This methodology integrates 2 ways of statement specifically, Multiple Regression and ARIMA statistic and computes the new coefficients with most likelihood algorithmic program. However, regression with ARIMA error failed to end in a way higher output compared to ARIMA and Exponential smoothing. The explanation is that finding applicable factors to predict the response variable demand the high level of sophistication in product demand analysis. Sadly, because of the dearth of adequate interaction with NYNAS, only a short variety of things are detected.

Thus, the R-square price of regression is below four-hundredth for all merchandise. Usually exponential smoothing and ARIMA methodology would possibly turn out additional precise forecast. However, by using regression with ARIMA error, we've got the power to interpret the meddlesome factors and therefore the reason for perceptive completely different behaviors.

Having calculated the mean of MAPE for all statement ways, we tend to were interested to ascertain if the statement methodology may be an important issue and if the distinction between the typical values obtained by ARIMA is statically completely different from alternative ways. To do so, we tend to run the irregular block style methodology and by drawing the most impact plot we've got return to the present conclusion that forecasting methodology will be thought-about as a big issue and by running 2 Sample T take a look at in MINITAB and by considering ninetieth confidence interval, the ARIMA methodology outperforms other ways considerably.

Hyndman and Koehler (2006) studied on forecasting accuracy. They discuss and compare measures of accuracy of unilabiate time series forecasts. The methods used in the M-competition as well as the M3-competition. They have found these method can give infinite or undefined values in commonly occurring situations. They propose that the mean absolute scaled error become the standard measure for comparing forecast accuracy across multiple time series.

Despite 20 years of papers on measures of forecast error, they tended to believe that some basic problems are unnoticed. Especially, the measures employed in the M-competition and also the

M3-competition, and also the measures counseled by alternative authors, all have problems they can provide infinite or indefinable values in usually occurring things. They proposed that scaled errors become the quality live for forecast accuracy, where the forecast error is scaled by the in-sample mean absolute error obtained victimization the naive statement method. This can be wide applicable, and is usually outlined and finite except within the moot case wherever all historical knowledge are equal. This new live is additionally simply interpretable: values of MASE bigger than one indicate the forecasts are worse, on average, than in-sample ballroom dance forecasts from the naive methodology. The mean absolute scaled error (MASE) was applied to the money supply knowledge and it absolutely was shown that it gave results that were in keeping with the most conclusions of the M3-competition. It also allows a lot of powerful tests of the distinction between strategies than the sample.

2.2.4. Demand Forecasting

Hart, Lukoszova and Kubikova (2013) studied on logistic managements based on the demand forecasting. They found foundation of any logistics management system which is composed in common industrial company of purchasing, production, packaging and identification, warehousing, distribution and reverse material flow management subsystems, it's progressive independent demand forecasting system gives inputs data for sub-sequent planning, management and control processes. As a results of still rising material, money and knowledge flows across provide chains of explicit industries, the businesses are progressively complete to use progressive provision management strategies to manage. The large material flows represent extended money resources that it's necessary effectively set up, manage and management underneath current competitive business setting to achieve success.

In consequence of up to date robust economic process trend of commercial and ultimate markets thereby additionally economic process trend of their provide chains, the companies are applying systems of method management across explicit useful levels and at the same time a lot of and a lot of they implement provision principles of fabric flow management as a results of increasing material flows volume and quality. As a results of rising volume of international business is a rise of flows intensity across explicit provision infrastructure cities. That during a final result will increase the importance of provision management principles additionally in tertiary sphere. Thus,

the principles or approaches of provision management underneath current globalized market setting are crucial to reinforce a fight of commercial corporations in context of semi-permanent property growth and living setting protection.

The foundation of any provision management system that consists in common industrial company of buying, production, packaging and identification, reposting, distribution and reverse material flow management subsystems, it's progressive freelance demand statement system offers inputs information for sub-sequent designing, management and management processes.

Chai, Wang, Shouyang and Guo (2012) researched on demand forecasting of petroleum product consumption in the Chinese transportation Industry. This was supported the theorem linear regression theory and Markov chain Monte Carlo methodology (MCMC), establishing a demand-forecast model of gasoline and diesel consumption introduced into the analytical framework with informative variables of urbanization level, per capita GDP, turnover of passengers (freight) in mixture (TPA, TFA), and civilian vehicle range (CVN) and explained variables of gasoline and diesel consumption.

As one of major economic sectors of the entire nation, transportation is sort of entirely dependent on the consumption of rock oil product. Particularly given the worldwide energy security problems and things like that, the conclusion of property development and management during this sector can become a strong challenge for governments to deal with. What's a lot of, the long run growth of this sector still has a strong momentum for developing, and can any enhance the proportion of energy consumption of this sector in total. Moreover, the event surroundings is stressed by many another research worker once analyzing the economy problems and practitioners further. Consequently, it's useful to forecast the energy demand moderately for this sector while it's fully crucial for cathartic the pressure of each energy and surroundings demand. In the method of empirical analysis during this paper, we have a tendency to introduce 5 informative variables into the model: urbanization level, per capita GDP, turnover of traveller in combination (TPA), turnover of freight in combination (TFA), and civilian vehicle variety (CVN). Then, a model expression of gasoline and diesel consumption is obtained supported comparison with 2 models of un- and power forms. Besides, supported theorem statistical regression theory and also the MCMC rule we have a tendency to get the stable coefficients and constant calculable values with stability

and convergence tests. The results of regression analysis show that urbanization is that the sensitive issue with strongest marginal impact on petrol and diesel consumption in transportation. From the prediction interval worth, urbanization expresses the lower limit of the anticipated results, and CVN the higher limit of the anticipated results. Predicted values from alternative freelance variables, say per capita GDP, TPA, and TFA, are in the range of foreseen values that indicates the validation vary and reference commonplace area unit abundant more credible. Generally, the approaching few years can see.

Sebastien Thomassey (2010) done study on sales forecasting in clothing industry. He is found different forecasting model need to use short term and long term. It will give better forecasting accuracy. And also found need to put correct information to the forecasting tool in order to minimize error. If has error it lead to increase the unnecessary inventory.

Features of the covering provide chain involve 2 completely different horizons of forecast: along-term horizon (about one year) and a short-term horizon (few weeks).Consequently, forecasting models ought to logically be tailored to the chosen horizon since constraints aren't similar. For long horizon, proposed models. Sales forecasts with a short-run horizon is performed with a neural network that permits the system to update the long-term forecasts per the last better-known sales. These two models square measure correct and suit well to the covering market constraints. However, they need historical sales. Consequently their use is restricted to the family of things (i.e. the lowest level of aggregation wherever historical sales exist).

For sales forecast satiate level, no historical sales square measure on the market since things square measure substituted every assortment, projected solutions involve data processing techniques like agglomeration and classification ways. All these techniques will effectively reply to market

Requirements in terms of forecast. However, the key success factor is that the existence, relevancy and responsibility of information contained in data systems of distributors. This last purpose is usually the primary reason behind inaccurate forecasts within the field of covering.

At last, a simulation of the prediction and therefore the sourcing processes of square measure merchant and a manufacturer permits North American country to quantify the impact of the forecast errors on the financial and supply performances. They tended to demonstrate that errors

on initial forecasts involve a rise of inventory levels, lost sales and consequently of the profit margin for the merchant. Inventory levels and repair level of the manufacture rare additionally compact. Error-sin consumer demand generate additionally arise of their retailer's orders that disturbs the assembly arrange of the manufacturer. This could be taken because the starting of the bull whip result. A simulation as well as extra firms ought to demonstrate that this bull whip result would be propagated up stream of the chain. Advanced prediction system economical thanks to reduce this negative development for the fashion industry.

However, within the terribly volatile covering market, if firms need a further improvement of their flexibility and their hardiness they should first off implement an appropriate prediction system and

Secondly they ought to look for to reconstitute and rethink their provide chain to scale back the lead times and minimum order quantities.

Gaur, Osadchiy and Seshadri (2008) studied sales foresting with financial indicator in retail sales. They have found correlation coefficient of sales forecast error with the financial market return is significant, and varies across firms depending on the retail segment, the gross margin, and the term of the forecast and also combined forecast lead to increase the accuracy of the forecasting. They have develop the model for sales forecast.

They develop a model of joint evolution of the monetary market and also the future sales for every company for each year. Through this analysis, they construct 2 equations, one for estimating the parameters of our model and testing the hypotheses, and another for change forecasts exploitation monetary market information. They omit the firm and year indices for convenience. They shall introduce these indices later after they specify the estimation procedure and knowledge.

The volume of retail sales is often understood to be related with the state of the economy. This info will probably be used in demand prognostication, operations decisions, and risk management. They have tended to propose a model within which the whole sales of a merchant is operate of sales forecasts generated by equity analysts, the term of the forecast, and the come back on associate mixture monetary market index over the term of the forecast. They tested this model on a panel of four,698 observations of annual firm-level sales forecasts for ninety seven retailers over ten years, annually containing multiple forecasts of variable terms. They tended to show that the

Correlation coefficient of sales forecast error with the monetary market come back is critical, and varies across companies looking on the retail phase, the margin of profit, and also the term of the forecast. Our model provides results on alternative parameters for prognostication furthermore, and a technique for forecast change. They tended to show that forecast updates from our model give new info not contained within the forecast updates by equity analysts, in order that a combined forecast leads to improved forecast accuracy. These results have applications in forecast change, decision postponement, production coming up with, and risk management.

Frank, Garg, Raheja and Sztandera (2003) studied for forecast women's apparel sales using mathematical modeling. They have used two model such as statistical time series modeling, and modeling using ANNs (artificial neural networks), for observed correlation with actual sales. They found lower correlation between the actual and forecasted sales and time series analysis good model for forecast.

Time series analysis perceived to be quite effective in statement sales. In all the 3 models, R2 and therefore the correlation coefficients were considerably high. The 3 parameter winters' model outperformed SSES in each explaining variance within the sales information (in terms of R2) and statement sales (in terms of correlation coefficient).

ANN model performed best in terms of R2 among 3 models. But correlations between the particular and forecasted sales weren't satisfactory. A potential downside once operating with shouting information, an oversized range of inputs, and small coaching sets is that the alleged over-fitting. Since huge ANN models will approximate primarily any perform, they will conjointly over work every kind of noise perfectly. Sadly, all 3 conditions that increase the danger of over fitting are consummated in our domain. Typically, sales information have a high amplitude.

The problem is intense by variety of outliers (exceptionally high or low values). A variable formal logic based mostly model may model the sales o.k., as it would take under consideration more influence factors additionally to time. This naturally ends up in the primary extension of this work. Extensions of the construct of discovery learning are unit of current interest and are unit being investigated.

As per the above mentioned literature, describe the importance of have a better sales forecast for organization. Here also mentioned difference method which can use for forecasting such as ANN, hybrid method.

CHAPTER THREE

Methodology

3.1. Research Design

This Research started from historical data collection to forecasting of future sales.

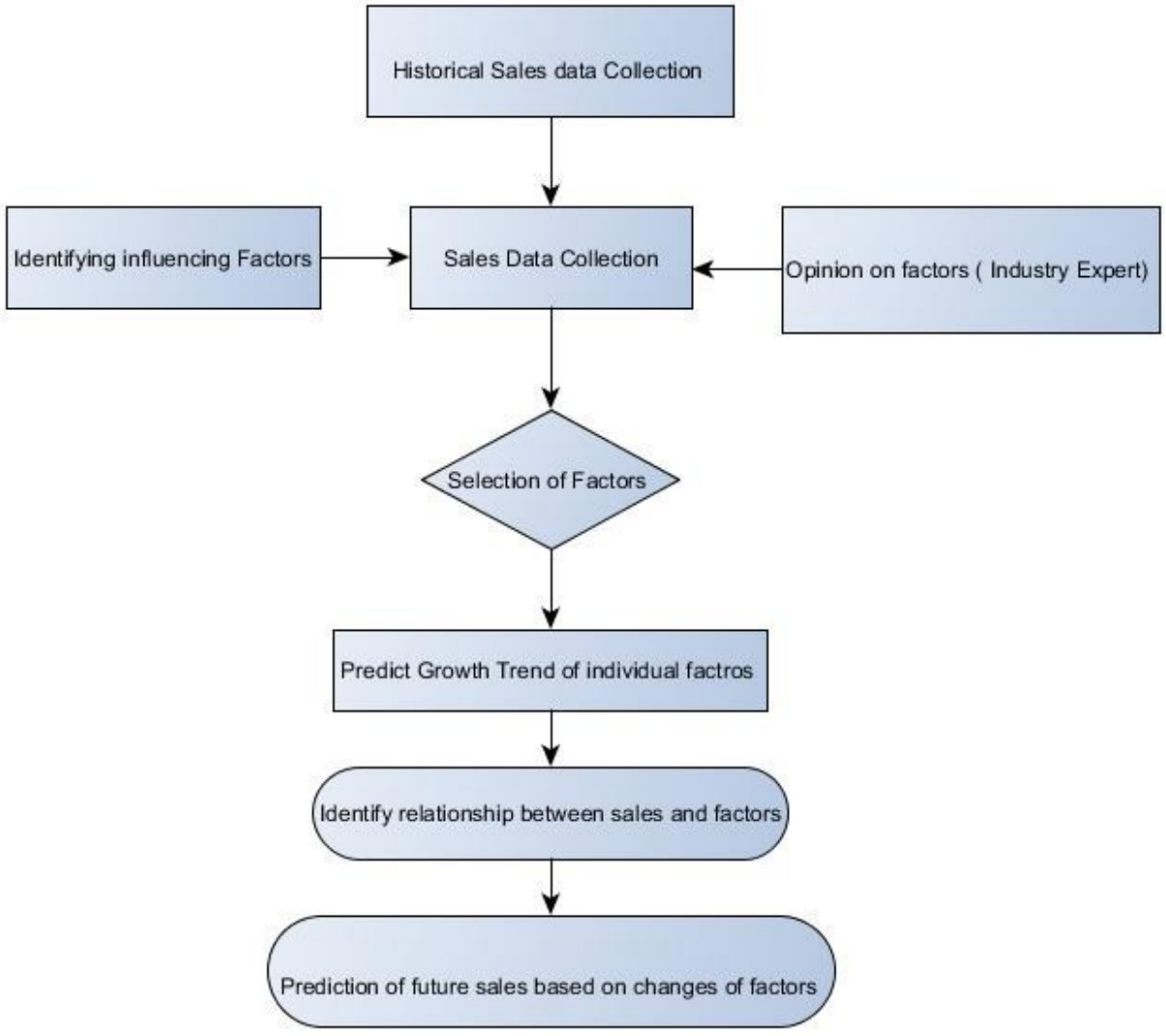

Figure 2: Research design

3.2. Population & Sample

In this study, company sales forecast and actual sales data collected from 2012- 2016. And also used national account data 2012- 2016, such as GDP growth, annual import value and all island paddy production. Furthermore used new vehicle registration and vehicle population data published by departments of motor traffic from 2012-2016.

3.3. Data collection

3.3.1. Primary data sources

For this research, company sales forecast date and actual data use which is kept in MIS.

3.3.2. Secondary data sources

For this research, used national account data and data published by departments of motor traffic.

3.4. Data analysis

The study attempt to investigate the factors affecting to lubricants demand and develop the forecasting model based on identified factors. The data used in this study for the period of 2012 to 2015 for the analysis and 2016 date use for verification. Here data presented using graph and tables.

3.5. Descriptive analysis

The study attempt to analysis the data further to using MINITAB software for the analysis the correlation and regression analysis. And also for the analysis use annual data and quarterly data of selected factors.

3.6. Model Developments

3.6.1. Conceptual framework

This research study is based on the following model and it shows the relationship between the lubricants demand and it determinations. The main eight factors was identified as independent variables (GDP growth, vehicle population , export, seasonal impact of paddy production, product, price, place, promotion) and lubricants demand can be identified as dependent variable. In this research marketing mix not consider due to unavailability of some data and company not allowing publish some date like marketing expenditure. In this study, use expert interviews for identify the factors which is affecting to lubricants demand such as GDP growth, vehicle population, export value and seasonal as well as literature review such as product, price, place and promotion.

Dependent Variable	**Independent Variable**
Lubricants Demand	**Sales Forecast** ➢ GDP growth ➢ Vehicle population ➢ Export ➢ Seasonal- Paddy production **Marketing Mix** ➢ Product ➢ Price ➢ Place ➢ Promotion

Figure 3: Conceptualization

CHAPTER FOUR

Research Findings

4.1. Introduction

This chapter includes collected data presentation, analysis and discussion. Data presentation includes sales and macroeconomics variables data. This data presentation includes factors, which effect to lubricants demand. Finally, this chapter includes analysis and discussion of collected data. Here, the researcher is used tables, graphs to data presentation and correlation and regression analysis use to analysis. Under the data collection method, the study has used primary date which is in company MIS and national account data which is published. Furthermore done scenario analysis once after selecting most suitable model as per the practical situation.

4.2. Data Screening

4.2.1. Sales

In this research, initially consider annual sales volume (table 3) for analysis and model developments

Table 4: Sales Volume

MONTH	SALES VOLUME (L)				
YEAR	***2012***	***2013***	***2014***	***2015***	***2016***
Jan	220,085	164,694	242,237	201,712	310,109
Feb	211,710	162,268	250,440	258,258	291,643
Mar	136,466	109,878	265,113	271,204	316,867
Apr	171,383	128,047	187,030	186,455	175,854
May	206,556	126,568	278,347	230,304	183,494

MONTH	SALES VOLUME (L)				
YEAR	***2012***	***2013***	***2014***	***2015***	***2016***
Jun	121,103	109,970	269,585	254,096	280,981
Jul	135,301	142,629	266,142	230,102	250,902
Aug	161,216	153,476	233,370	263,277	308,137
Sept	151,287	170,635	250,407	255,265	319,335
Oct	155,996	157,591	210,917	251,533	353,932
Nov	117,409	188,532	200,219	201,896	363,455
Dec	103,461	200,040	200,912	204,746	313,129
Total Sales	**1,891,972**	**1,814,327**	**2,854,721**	**2,808,847**	**3,467,839**

Comparing to the period, in the 2013 total sales volume reduce by the 4% but company able to maintain 1.8 million liter per annum in the both years. In the 2014 comparing to the 2013 company able to achieve highest sales growth for the period. It is 57% growth than the 2013. But in the 2015 again company loss its total sales by 2% but only 45,874 liters. But in the 2015 also company able to maintain its sales volume around 2.8 million liters. Considering 2012 and 2013, company able to secure their incremental volume generated in 2015. In the 2016 company able to achieve its highest sales volume. It is 3.4 million liters and almost its 3.5 million liters. Its 23% sales growth comparing to 2015. And also it's an 83% sales growth than the 2012 sales volume.

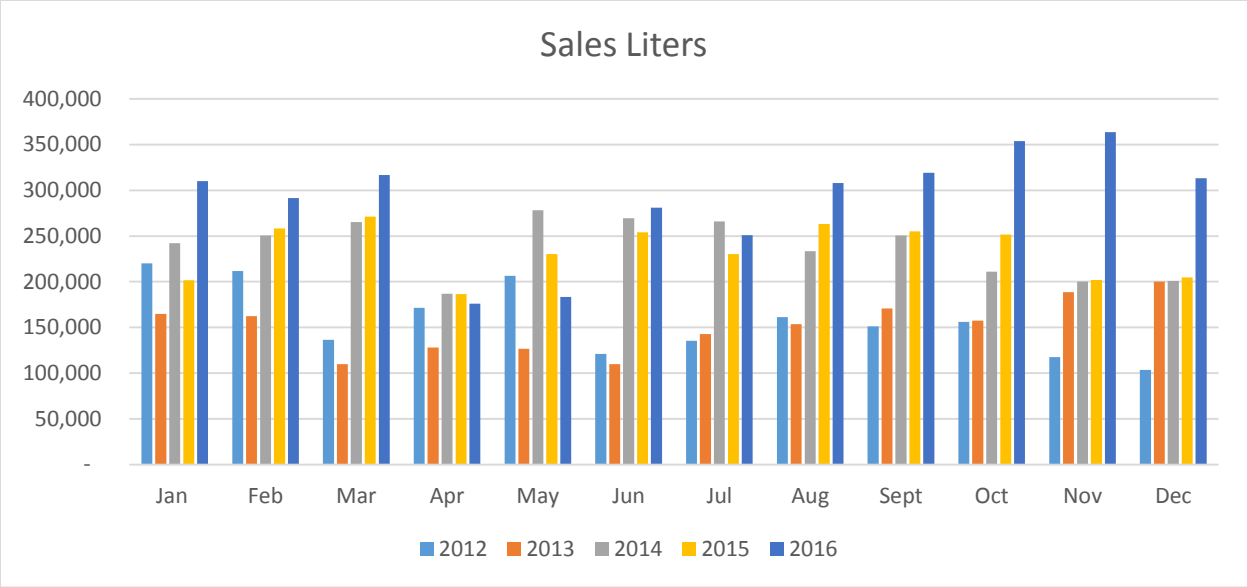

Figure 4: Monthly sales volume

4.2.2. Vehicle population, GDP, All island Paddy production, Export

Table 5: Annual vehicle population, GDP, All island paddy production and exports

Year	VEHICLE POPULATION	GDP (g)	All island paddy production (Kg)	Exports (RS Mn)
2012	4,877,027	9.1	3,845,900.0	1,245,531
2013	5,203,678	3.4	4,620,700.0	1,344,054
2014	5,633,234	5.0	3,380,800.0	1,453,176
2015	6,302,141	4.8	4,819,400.0	1,431,431
2016	6,795,469	4.4	4,420,100.0	1,500,766

Source: Departments of motor traffic data, center bank annual report

Comparing to the period which is consider, vehicle population increased year to year. As percentage in 2013 it increase by 7% and 8%, 12%, 8% increased by 2014, 2015, 2016 respectively. In the 2015 it increments marked as 12% and it is the highest increments for the period. Reducing vehicle importation tax lead to this increment.

In 2012, GDP marked its highest value as 9.1 % growth. But after that GDP growth rate reduced to 3.4% and then after recent year in 2014 GDP growth rate increased to 5%. But in the 2015 and 2016 it GDP growth rate reduced to 4.8% and 4.4% by respectively.

Considering all island paddy production, in the 2013 it is increased by 20% and then after recent year (2014) all island paddy production reduced by 27%. But in the 2015 all island paddy production increased by 43% and it's the highest production quantity 4,819,400 kg, which is marked for the considering period. But in the 2016 all island paddy production reduced by 8%. Sri Lankan country weather condition changes highly affected to variation of the paddy production.

Except the 2015, export volume increased by year to year. In the 2013 and 2014 export increased by 8% but in 2015 export volume reduce by 1% comparing to the 2014. In the 2016 export increased by 5% and it is the highest value (1,500,766.00 LKR million) marked in the period.

4.3. Descriptive analysis using annual data

For the evaluation, sales volume, vehicle population al island paddy production and export value data round up to three figure as mention in the table 5.

Table 6: Descriptive analysis for sales volume, vehicle population al island paddy production and exports

Year	SALES VOLUME (L)*	VEHICLE POPULATION*	GDP (g)	All island paddy production (Kg)*	Exports (RS Bn)#
2012	1.32	4.88	9.10	3.85	1.25
2013	1.81	5.20	3.40	4.62	1.34
2014	2.85	5.63	5.00	3.38	1.45
2015	2.81	6.30	4.80	4.82	1.43
2016	3.47	6.80	4.40	4.42	1.50

Source: Departments of motor traffic data, center bank annual report data (round up)

Based on the data shown on the table 5, run the correlation using MINITAB to find the relationship between the identified factors and sales volume.

4.3.1. Sales Volume and Vehicle population

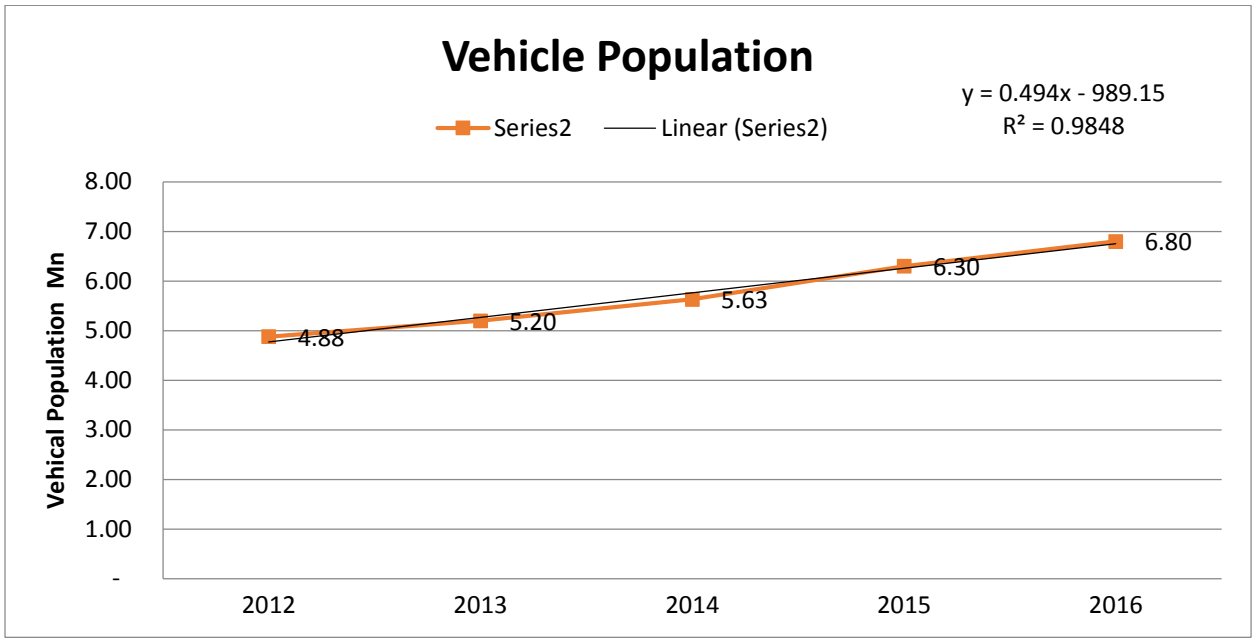

Figure 5: Annual vehicle population

Considering Sales volume and vehicle population, found $R^2 = 0.9848$. It mean here have strong relationship with sales volume of lubricants and vehicle population. Therefore can take vehicles population as a considerable factor for the forecasting model developments. In figure 6 shows its behavior throughout the period which is studied. Here vehicle population continually increase and sales volume also increasing. But some time sales volume have decreasing trend as well.

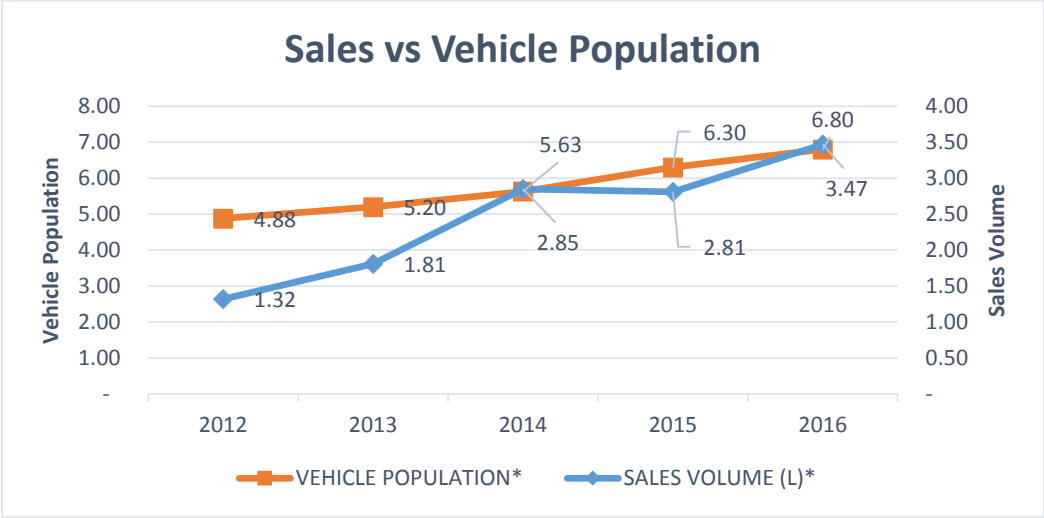

Figure 6: sales vs vehicle population

4.3.2. Sales Volume and GDP growth rate

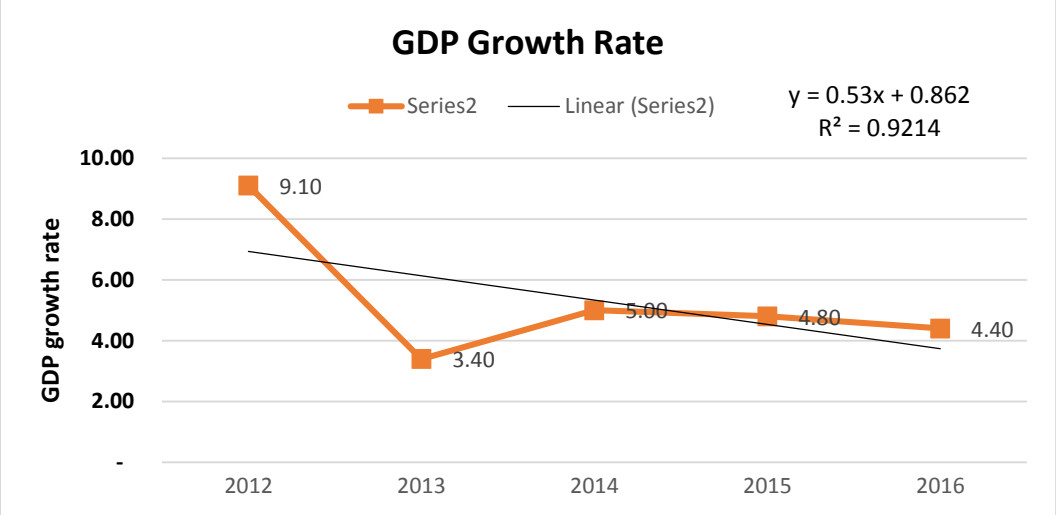

Figure 7: GDP growth

Considering Sales volume and GDP growth rate, found $R^2 = 0.9214$. It mean here have strong relationship with sales volume of lubricants and GDP growth rate. Therefore can take GDP growth rate as a considerable factor for the forecasting model developments. As mentioned in figure 8, especially GDP growth rate shows continues decreasing trend. Its recorded 9.10 as 2012 and drop down up to 4.40 in 2016.

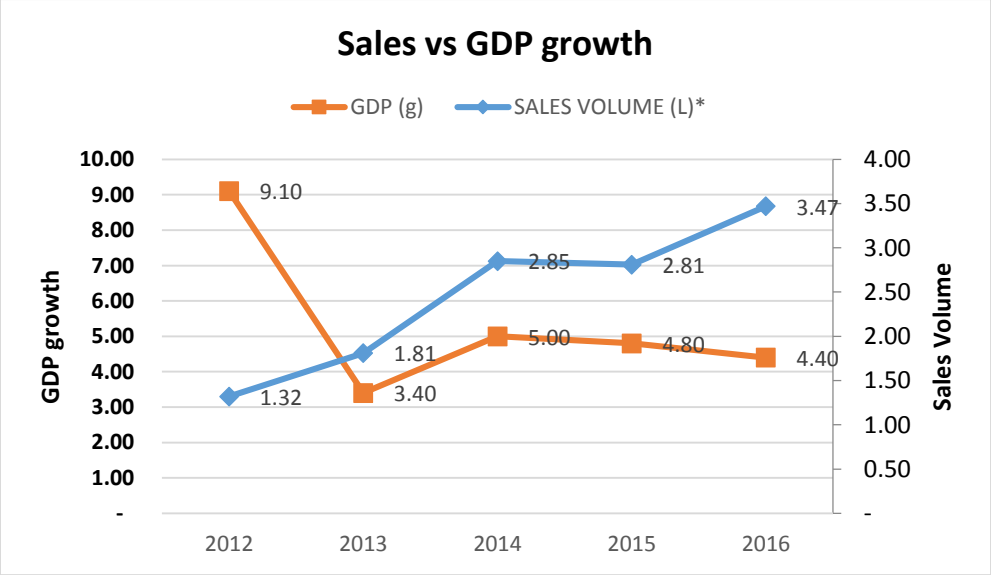

Figure 8: Sales vs GDP growth

4.3.3. Sales Volume and All island paddy production

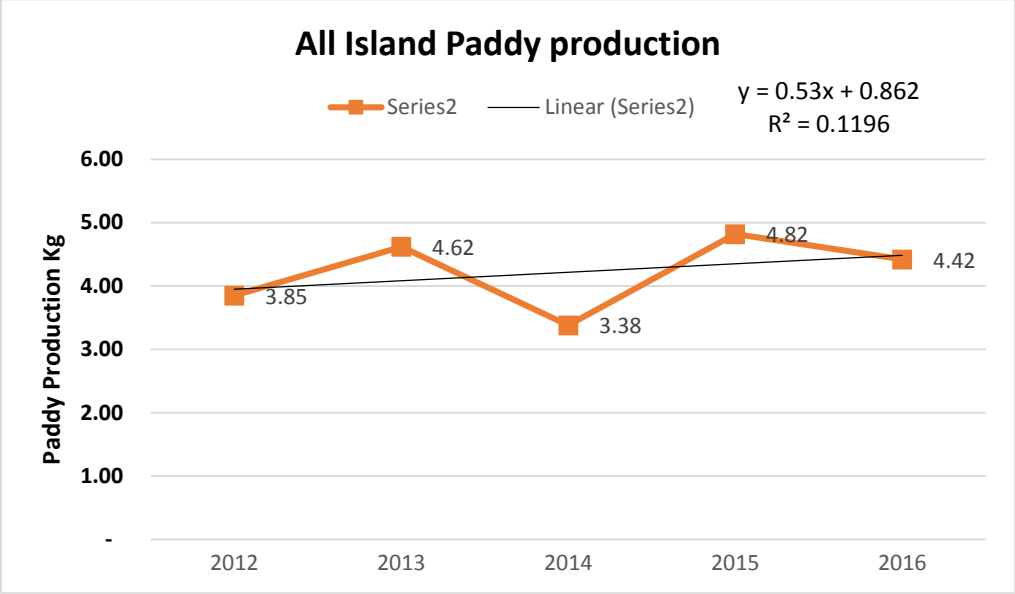

Figure 9: All island paddy

Considering Sales volume and all island paddy production, found $R^2 = 0.1196$. Its mean here have not strong relationship with sales volume of lubricants and all island paddy production. Therefore all island paddy production will not take as considerable factor for the forecasting model developments. As mentioned in the figure 9, paddy production haven't identified trend for the period. Some year it's increasing while decreasing some year.

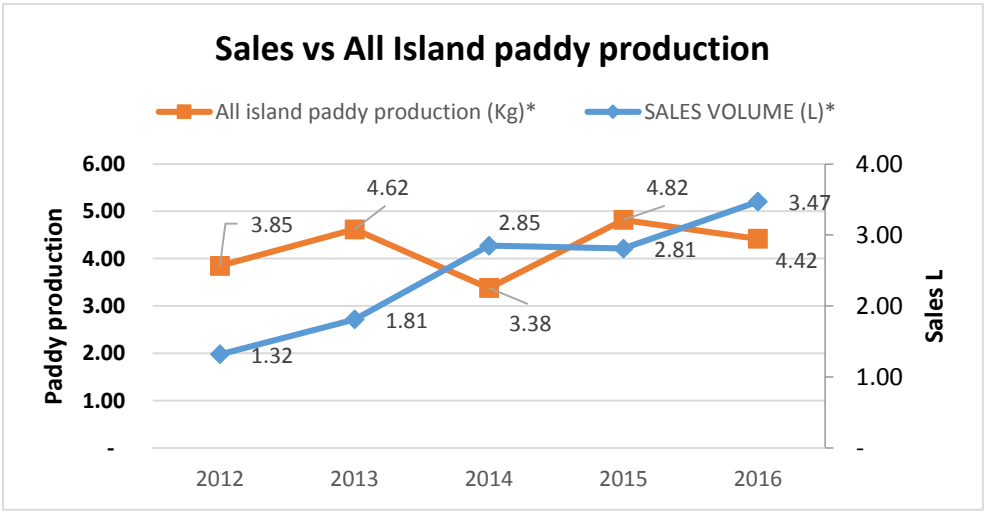

Figure 10: Sales vs All Island paddy production

4.3.4. Sales Volume and export

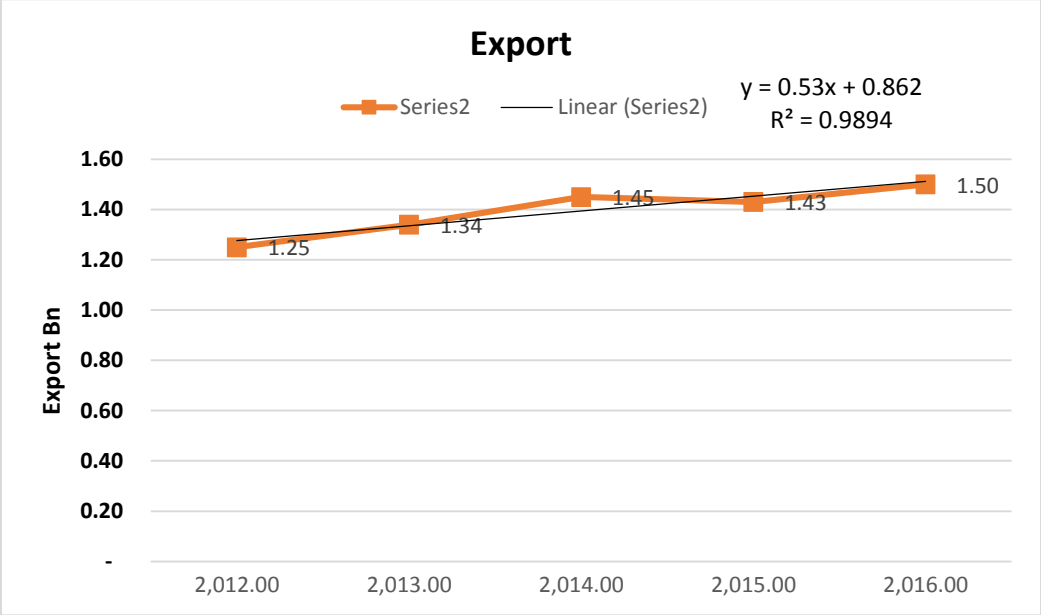

Figure 11: Annual exports

Considering Sales volume and export value, found $R^2 = 0.9894$. Its mean here have strong relationship with sales volume of lubricants and export value. Therefore can take export value as a considerable factor for the forecasting model developments. As shows in the figure 12, export value also continually increasing 2012- 2016 period. Here sales as well as export value has mostly same trend pattern.

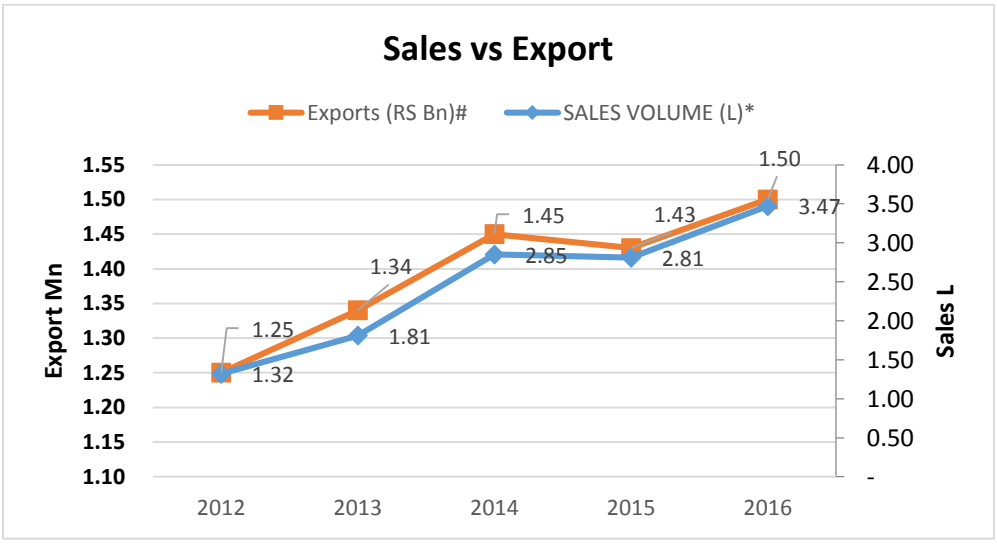

Figure 12: Sales vs export value

4.4. Descriptive analysis using quarterly data

4.4.1. Sales data

In this research, secondly consider quarter wise and category wise sales volume (table 6) for analysis to find whether have any seasonal impact.

Table 7: Quarter wise sales volume

	Year	Diesel Products	PCM	Three Wheeler/ MCO	Industrial	Other
Q1	**2012**	228,423	28,551	216,638	115,229	42,433
	2013	131,898	18,404	151,663	92,955	41,191
	2014	267,555	24,398	267,349	143,418	55,017
	2015	292,205	17,908	176,842	196,378	47,793
	2016	310,907	20,800	276,677	242,817	63,683
Total		**1,230,988**	**110,061**	**1,089,169**	**790,797**	**250,117**
Q2	**2012**	206,788	25,057	164,122	73,300	33,752
	2013	121,822	16,270	138,216	61,421	30,033
	2014	270,606	21,008	258,439	140,646	44,199
	2015	255,102	19,439	170,212	167,390	57,808
	2016	183,034	19,927	262,896	136,438	32,057
Total		**1,037,352**	**101,701**	**993,885**	**579,195**	**197,849**
Q3	**2012**	146,962	20,279	146,774	101,628	37,712
	2013	140,216	16,389	161,342	101,205	34,981
	2014	255,582	21,099	218,197	195,340	59,668
	2015	263,872	19,935	217,348	194,302	46,796
	2016	236,097	20,427	342,692	188,996	81,564

Total		**1,042,729**	**98,129**	**1,086,353**	**781,471**	**260,721**
Q4	**2012**	128,900	19,366	137,230	68,505	28,909
	2013	173,337	19,122	205,248	106,489	41,556
	2014	211,876	20,434	168,600	164,577	46,504
	2015	232,943	17,881	164,573	193,495	46,496
	2016	273,380	26,751	381,364	224,880	109,364
Total		**1,020,436**	**103,554**	**1,057,015**	**757,946**	**272,829**

4.4.1.1. Diesel Category

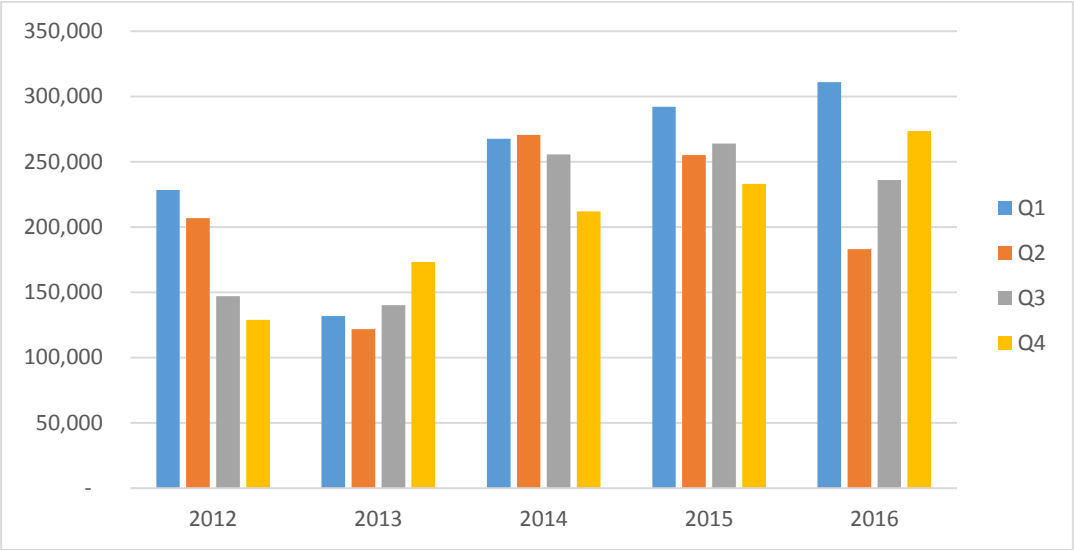

Figure 9: Quarter wise sales volume – Diesel category

Comparing to the period, sales of diesel category decrees from the first quarter 2012 and it is continue up to 3rd quarter of the 2013. Then sales of the diesel category starting to increase sing trend in 4th quarter in 2013 and it is continue up to second quarter of the 2014. Here not able to identify the similar pattern in the same quarter in each year.

4.4.1.2. Petrol Category

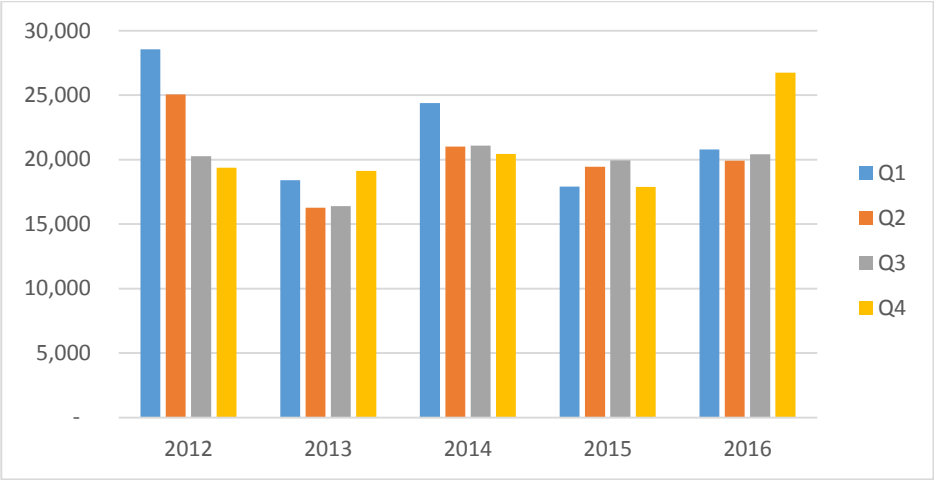

Figure 10: Quarter wise sales volume – Petrol category

Comparing to the period from 1st quarter of the 2012, sales of the petrol category continuously reduce up to 2nd quarter of the 2013. Then it is increased up to 2nd quarter of the2014. Here also not able to identify similar pattern for same quarter in the each year.

4.4.1.3. Motor Cycle/ Three wheel category

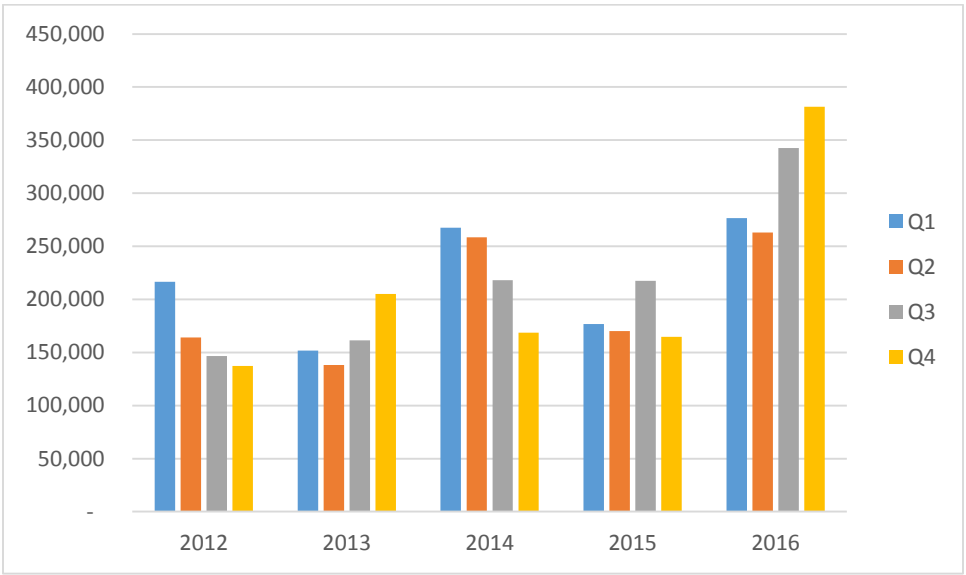

Figure 11: Quarter wise sales volume – Motor cycle / three wheeler category

Comparing to the period, in the 2012 sales of the motor cycle and three-wheeler oil reduced up to fourth quarter of the year. But then 2013 it is increased in except the second quarter until first quarter of the 2014. Here not able to identify the similar pattern for the same quarter of the each year.

4.4.1.4. Industrial Products

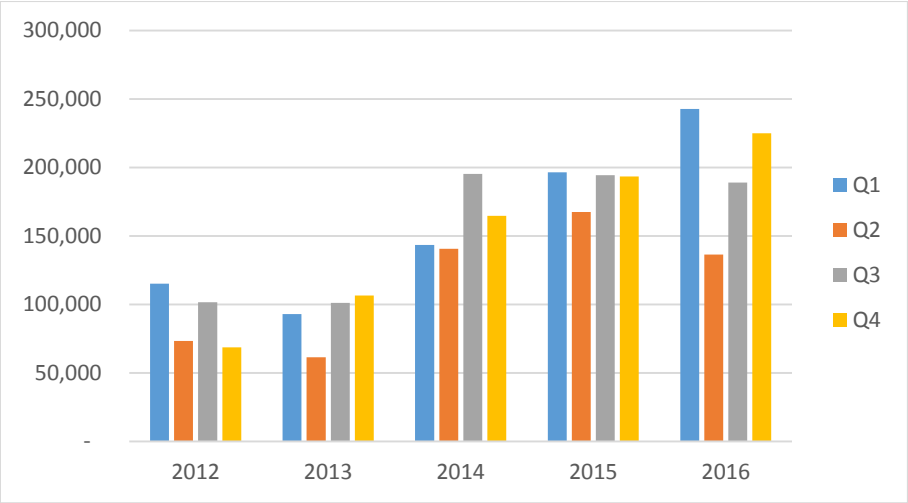

Figure 12: Quarter wise sales volume – Industrial Products

Comparing to the period, first and fourth quarter of the 2016 marked highest sales for the period. But from the first quarter of the 2012, not able to identify the similar pattern for the same quarter of the each year.

4.4.1.5. Other Type

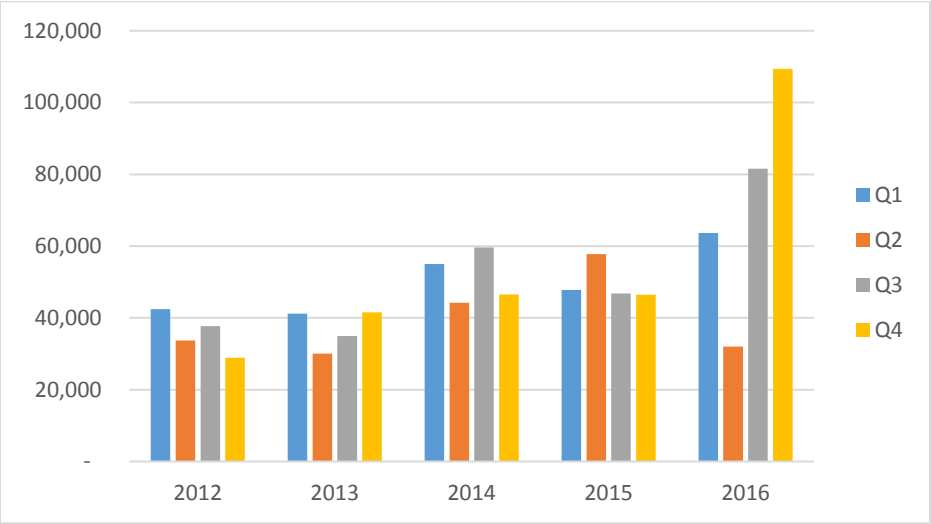

Figure 13: Quarter wise sales volume – Other type

Other product types include grease, brake oil and auto transmission oil. Comparing to the period last quarter of the 2016 marked highest sales volume of the other products types. But here also not able to identify the similar pattern for the same quarter of the each year which is considered.

4.5. Model Developments

For the model developments firstly consider annual data of the factors which is have strong correlation with lubricants sales. Those are the vehicles population, GDP growth, Export value. After the run regression analysis using MINITAB bellow model developed,

Table 8: Developed Model

Model Number	Variable	Model (Annexure)	P - Value	R- Sq
1	Sales + VP	= -3.81+1.092 VP	0.115	78.35 %
2	Sales + GDP	= 3.15- 0.171 GDP	0.444	30.88 %
3	Sales + Export	= -8.94+8.145 Export	0.013	97.44 %
4	Sales + VP+ GDP	= - 3.01+ 0.996 VP- 0.049 GDP	0.444	80.25 %

5	Sales + VP+ Export	= - 8.42+0.238 VP+6.81 Export	0.121	98.54 %
6	Sales + GDP + export	= - 10.63+0.0563 GDP+ 9.149 Export	0.084	99.29%
7	Sales+ VP+GDP+ Export	= -10.04+0.1931 VP+0.05061GDP+7.963 export	0.000	100 %

For the model developments secondly check the correlation of the selected variable such as vehicle population, GDP growth and export value based on the category vise sales data and quarter vise data. Considering category vise less correlation identified with selected factors,

Correlations: Diesel Products, Vehicle Population

Pearson correlation of Diesel Products and Vehicle Population = 0.560

P-Value = 0.010

Correlations: Diesel Products, GDP

Pearson correlation of Diesel Products and GDP = -0.115

P-Value = 0.630

Correlations: PCM, Vehicle Population

Pearson correlation of PCM and Vehicle Population = -0.024

P-Value = 0.919

Correlations: PCM, GDP

Pearson correlation of PCM and GDP = 0.183

P-Value = 0.439

Correlations: Three Wheeler/ MCO, Vehicle Population

Pearson correlation of Three Wheeler/ MCO and Vehicle Population = 0.676

P-Value = 0.001

Correlations: Three Wheeler/ MCO, GDP

Pearson correlation of Three Wheeler/ MCO and GDP = -0.139

P-Value = 0.558

Correlations: Industrial, Vehicle Population

Pearson correlation of Industrial and Vehicle Population = 0.818

P-Value = 0.000

Correlations: Industrial, GDP

Pearson correlation of Industrial and GDP = -0.383

P-Value = 0.096

Correlations: Other type, Vehicle Population

Pearson correlation of other type and Vehicle Population = 0.670

P-Value = 0.001

Correlations: Other type, GDP

Pearson correlation of other type and GDP = -0.124

P-Value = 0.601

As per the correlation result, when we considering category vise and quarter vise data here not able to find relationship with sales and other variable such as vehicle population and GDP except the one relationship. It is industrial products and vehicle population shows higher relationship and its only relationship shows in category type and quarter vise data analysis. For the quarterly wise analysis have not consider export value due to unavailability of quarter vise data.

Other than the category wise date, in this research analysis the individual correlation among the factors. Here vehicle population and export shows some correlation but others have not strong correlation. Therefore even though GDP include paddy production and export, it will not affect to the final model developments.

Correlations: VEHICLE POPULATION*, GDP (g)

Pearson correlation of VEHICLE POPULATION* and GDP (g) = -0.500

P-Value = 0.391

Correlations: VEHICLE POPULATION*, Exports

Pearson correlation of VEHICLE POPULATION* and Exports = 0.895

P-Value = 0.040

Correlations: GDP (g), Exports

Pearson correlation of GDP (g) and Exports = -0.662

P-Value = 0.224

Correlations: VEHICLE POPULATION*, All island paddy production (Kg

Pearson correlation of VEHICLE POPULATION* and All island paddy production (Kg) = 0.398

P-Value = 0.506

Correlations: GDP (g), all island paddy production (Kg

Pearson correlation of GDP (g) and All island paddy production (Kg) = -0.461

P-Value = 0.434

Correlations: Exports, All island paddy production (Kg

Pearson correlation of Exports and All island paddy production (Kg) = 0.117

P-Value = 0.852

4.6. Comparison

As per the developed model by using regression analysis, it was used for forecasted future sales by using 2016 actual data.

Table 9: sample Data

Variable	Year 2016 value
Vehicle Population	6.8
GDP	4.4
Export	1.5

Base on the mentioned date in table 9 done the sales forecasting. Result which is generated in developed models mention in the table 10.

Table 10: Forecasted and actual sales

	Variable	Model	R - Sq	Forecasted Sales	Actual Sales 2016	Model Accurate Level %	Model Error %
1	Sales + VP	= -3.81+1.092 VP	78.35 %	3.6156	3.47	95.9	4.1
2	Sales + GDP	= 3.15- 0.171 GDP	30.88 %	2.3976	3.47	69.10	30.90
3	Sales + Export	= -8.94+8.145 Export	97.44 %	3.2775	3.47	97.42	5.58
4	Sales + VP+ GDP	= - 3.01+ 0.996 VP- 0.049 GDP	80.25 %	3.5472	3.47	97.88	2.22
5	Sales + VP+ Export	= - 8.42+0.238 VP+6.81 Export	98.54 %	3.4134	3.47	98.37	1.63
6	Sales + GDP + export	= - 10.63+0.0563 GDP+ 9.149 Export	99.29%	3.9312	3.47	86.71	13.29
7	Sales+ VP+GDP+ Export	= -10.04+0.1931 VP+0.05061GDP+7. 963 export	100 %	3.4403	3.47	99.15	0.85

In the 2016 actual sales 3.47 million liters (roundup to get close picture) and after the developed model checked by using actual sales volume of 2016 and other variable such as vehicle population, GDP and export value.

As per the first formulation considered sales and vehicle population (VP) as variables for regression analysis. Then after using actual data for forecasted sales 3.61 million liter for the 2016 while actual sales volume 3.47 million liters. Using this model company able to do sales forecast with 4.1% in higher side. Here model accurate level is 95.9 % for the forecasting.

As per second formulation considered sales and GDP growth percentage as variable for regression analysis. After the using actual data for forested sales is 2.39 million liters while actual sales volume 3.47 million liters. Using this model company able to do the sales forecast with 30.90% with lower side. Here model accurate level is 69.10% for the forecasting.

For the third formulation considered sales and export value as variable for the regression analysis and get 3.27 million liters sales forecasted for the year of 2016 while actual sales volume is 3.47 million liters. Using this model company able to get sales forecast with 5.58 % percent in lower side. Here model accurate level is 94.42% for the forecasting.

For the fourth formulation considered sales, vehicle population (VP) and GDP growth as variable for the regression analysis and get the 3.54 million liters as forecasted sales for the 2016 while actual sales volume is 3.47 million liters. Using this model they able to get sales forecast with 2.22% percent in higher side. Here model accurate level is 97.88% for the forecasting.

In fifth formulation considered sales, vehicle population and export value as variables for the regression analysis and get the 3.41 million liters as forecasted sales for the 2016 while actual sales volume is 3.47 million liters. Using this model they able to get sales forecast with 1.63% percent in lower side. Here model accurate level is 98. 37% for the forecasting.

In sixth formulation consider sales, GDP growth and export value as variable for the regression analysis and get the 3.93 million liters as forecasted sales for the 2016 while actual sales volume is 3.47 million liters. Using this model company able to get sales forecast with 13.29% present in higher side. Here model accurate level is 86.71% for the forecasting.

In final formulation consider sales, GDP growth rate, Vehicle population and export value as variable for the regression analysis and get 3.44 million liters as forecasted sales for the 2016 while actual sales volume is 3.47 million liters. Using this model company able to get sales forecast with 0.85% percent li lower side. Here model accurate level is 99.15% for the forecasting.

This research recommends the Model four with VP and GDP as one the best model among others since it gives lessor error (close estimation to the actual sales) and safer side forecasting (slightly higher side sales forecasting). With the selected Model four, the sensitivity analysis also carried out to with ±10% variation on both VP and GDP as depicted in Table 11. It is observed that VP is more sensitive to the sale furcating while GDP is not much compare to VP. Therefore, VP estimation must be carried out with greater care to get better sale prediction.

Table 11: Forecasted sales based on scenarios

Scenario	Model	Forecasted Sales	Sales Forecast without Scenario	Variance	Variance %
VP increase by 10%	= - 3.01+ 0.996 VP- 0.049 GDP	4.22448	3.5472	0.67728	19%
VP decrease by 10 %	= - 3.01+ 0.996 VP- 0.049 GDP	2.86992	3.5472	-0.6773	-19%
GDP growth increase by 10%	= - 3.01+ 0.996 VP- 0.049 GDP	3.52564	3.5472	-0.0216	-1%
GDP growth decrease by 10%	= - 3.01+ 0.996 VP- 0.049 GDP	3.56876	3.5472	0.02156	1%

CHAPTER FIVE

Conclusion and Future Research Direction

A lubricant is a fluid (engine oil, gear oil, car transmission liquid) or semi-solid substance (greases) which avoids coordinate contact between two neighboring moving parts of hardware. Lubricants can be mineral based produced using petroleum or manufactured detailing produced using unadulterated synthetic mixes.

The lubricant advertise is controlled and administered under the arrangements of the Petroleum Products (Special Provisions) Act No. 33 of 2002 and the Ceylon Petroleum Corporation Act No. 28 of 1961. The importation, exportation, blending, production, sale, supply and dispersion of lubricants including oils require particular approval from the Government. Approval is allowed only to qualified gatherings who have legitimate specialized ability and sufficient money related capacity, to guarantee that substandard items don't enter the market. Accordingly, when utilizing lubricants, just oils made and advertised by approved gatherings ought to be chosen.

LAUGFS Lubricant limited was incorporated in 2008 as private obligation organization. At first organization began imported and distribution of greases under the permit given by Ministry of Petroleum. In the year 2015 organization started new time with the cutting edge condition of craftsmanship blending plan. As of now organization offering lubricants under the Automotive and Industrial Category.

In this research develop models for sales forecasting and to develop those models eight factors have been identified through literature review and experts' opinions which can effect to lubricants demand. Then it was evaluated though the correlation test and selected three main factors such as Vehicle population, GDP growth and export value for the model developments. Here take only annual data due to show low relation among the factors while considering quarter vise data. Other factor such as product price place promotion not consider in this research. After the selected factors do the regression analysis and get the model for forecasting. Then using actual data for the 2016 do the sales forecasting and evaluated model result. As per the mention in the table 9, model four and seventh giving more accurate result for the forecasting. But considering practical scenario, model four is the most suitable model for forecasting. Because in practically company will not have forecasting with stock out situation.

Furthermore if not available one of these factors, such as if have only sales and vehicle population data Company still can do the sales forecasting with the 95.9% accuracy. If have sales data and GDP growth

company can forecast the sales with the 69.10 % accuracy. If the sales and export data available company can do the forecast 94.42% accuracy.

Evan though company have three variable such as if have only sales vehicle population and GDP growth company can do the sales forecasting with the 97.88% accuracy. If the company have sales, vehicle population and export value them able to do the sales forecasting with the 98.37 % accuracy. And also if the company have sales, GDP growth and export value them able to do the sales forecasting with the 86.71 % accuracy.

This research recommends the Model four with VP and GDP as one the best model among others since it gives lessor error (close estimation to the actual sales) and safer side forecasting (slightly higher side sales forecasting). With the selected Model four, the sensitivity analysis also carried out to with ±10% variation on both VP and GDP as depicted in Table 11. It is observed that VP is more sensitive to the sale furcating while GDP is not much compare to VP. Therefore, VP estimation must be carried out with greater care to get better sale prediction.

For the further direction of this research can evaluate factors such as product, price, place and promotion for develop the forecasting model with more information.

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